AEMSC

AUSTRALIAN EXPLOSIVES
MANUFACTURERS
SAFETY COMMITTEE

CODE OF GOOD PRACTICE

PRECURSORS
FOR
EXPLOSIVES

EDITION 1 - 1999

ABOUT THE AEMSC

The Australian Explosives Manufacturers Safety Committee (AEMSC), comprising representatives from Dyno Nobel Asia Pacific Ltd (previously Dyno Wesfarmers Limited), Orica Explosives (previously ICI Explosives), Union Explosives Espanol (UEE, previously ERT), and Total Energy Systems (TES), was formed in 1994. The goal of the AEMSC is to continuously improve the level of safety throughout our industry in the manufacture, transport, storage, handling and use of, precursors and explosives in commercial blasting throughout Australia.

COPYRIGHT

This document is subject to copyright. No parts of it should be reproduced without the written consent of copyright owner.

CONTENTS

Sect Subject Page

1.0 SCOPE 4

2.0 DEFINITIONS 5

3.0 SAFETY MANAGEMENT SYSTEM 8

4.0 REGULATORY REQUIREMENTS 11

5.0 DESIGN LAYOUT AND MATERIALS OF CONSTRUCTION 12

6.0 GUIDANCE NOTE ON LOCATION OF NEW PRECURSOR FACILITIES 14

7.0 HAZARD STUDIES 22

8.0 PUMPS 24

9.0 MAINTENANCE 26

10.0 MATERIALS HANDLING 27

11.0 PERSONNEL 28

12.0 WASTE MANAGEMENT AND ENVIRONMENTAL CONTROLS 30

13.0 TRANSPORT 31

14.0 APPLICATIONS FOR NEW PRECURSOR FACILITIES 33

15.0 APPENDIX 1 (Table 3.2.3.2 of AS2187.1-1998). 34

1.0 SCOPE

1.1 This code of practice was produced by a technical subcommittee of the AEMSC after a request from the Australian Chief Inspectors of Explosives. It sets out the recommendations and precautions to protect the health, safety and environment of the community, customers and employees in relation to the manufacture, storage, transport and use of precursors in commercial blasting operations. The code does not apply to the manufacture, storage, transport or use of Class 1 explosives.

1.2 The recommendations contained in this code are based on industry knowledge, Australian Standards and regulations, international guides and codes and advice from regulatory authorities.

NOTE: *Where there is conflict between the recommendations of this code and national or local legislative requirements, the legislative requirements shall always take precedence.*

2.0 DEFINITIONS

Class 1.1D explosives - Substances and articles which have a mass explosion hazard and have been classified as 1.1D by the appropriate regulatory authority. A mass explosion is one which affects almost the entire load virtually instantaneously.

Class 1.5D explosives - Substances which have a mass explosion hazard and have been classified as 1.5D by the appropriate regulatory authority. These substances are so insensitive that there is very little probability of initiation or transition from burning to detonation under normal conditions of transport.

Class 5.1 oxidisers - Substances which, while in themselves are not necessarily combustible, may by readily liberating oxygen, cause or contribute to the combustion of other material, and have been classified as Class 5.1 by the appropriate regulatory authority. These substances would be expected to fail the UN test for determining whether a material is a Class 1 explosive.

Cook-off - A process by which a mass of material is heated over a period of time, leading to a mass violent reaction without other means of initiation.

NOTE: A localised heat source may result in a cook-off of a portion of the total mass, which may trigger a reaction in the surrounding material.

Critical machine system - A machine system which has been assessed to present unacceptable consequences if the machine or its protective system should fail. This includes all failures or malfunctions, which could lead to danger to life, significant harm to any person or to the environment.

Deadheading - The operation of a pump when the outlet of a pump or discharge line is closed or blocked to prevent or restrict the flowrate.

Dry operation - The operation of a pump when its inlet is closed or blocked, or any other physical condition where the material being pumped is prevented from flowing freely into the inlet chamber of the pump.

Foreign bodies (tramp material)- Foreign material not common to a process (such as bolts, nuts, gravel, etc), that can have an adverse effect on the process and may cause an undesired event or deviation from the design intent.

Material safety data sheet (MSDS) - A material safety data sheet which is in accordance with the *Worksafe Australia Code of Practice for the preparation of Material Safety Data Sheets*. The MSDS is supplied for hazardous materials offered for sale or transport by the manufacturer or supplier of the material.

Net explosive quantity (NEQ) - The total mass of an explosive unless it has been determined that the effective quantity is significantly different from the actual quantity (based on TNT).

Packaging group (PG) - One of three hazard groups into which dangerous goods of other than Classes 1,2, 6.2 and 7 are designated in the Australian Dangerous Goods (ADG) Code for the Transport of Dangerous Goods by Road and Rail, in decreasing order of hazard, by the Roman numerals 'I' (great danger), 'II' (medium danger), and 'III' (minor danger). For example Ammonium Nitrate is classified as a PG III.

Precursor - A material resulting from a chemical or physical change when two or more substances consisting of fuels and oxidisers are mixed and where the material is intended to be used exclusively in the production of an explosive. In order for such substances not to be categorised as a precursor, evidence shall be produced demonstrating that the substance cannot cook-off leading to a mass violent reaction. Such evidence may include physical and/or chemical testing/modelling, end use profiles, detailed risk analysis or by analogy.

Precursor building - A building, in which a precursor is normally manufactured, stored and transferred and where no additional processing of the material into an explosive occurs.

Precursor facility - A facility where precursors are manufactured, handled or stored.

Process building - A building licensed by the appropriate regulatory authority for the manufacture or handling of explosives, other than for immediate use.

Protected works - The two classes of protected works are as follows:

(a) **Class A:** Public street, road or thoroughfare, railway, navigable waterway, dock**,** wharf, pier or jetty, market place, public recreation and sports ground or other open place where the public are accustomed to assemble, open place of work in another occupancy, river-wall, seawall, reservoir, above ground water main, radio or television transmitter or main electrical substation, a private road which is a principal means of access to a church, chapel, college, school, hospital or factory.

(b) **Class B:** A dwelling house, public building church, chapel, college, school, hospital, theatre, cinema or other building or structure where the public are accustomed to assemble; a shop, factory, warehouse, store or building in which any person is employed in any trade or business; a depot for the keeping of flammable or dangerous goods; major dam.

Regulatory authority - The authority having jurisdiction for administering legislation covering the manufacture, transport, storage and handling of dangerous goods within a particular State or Territory.

Shall/should - For the purpose of this document 'shall' is understood as mandatory and the word 'should' is advisory.

Standard operating procedures (SOP) - Written procedures containing an explicit description of how a job is to be performed. The SOP identifies the precautions required to safely complete the task, including -

(a) Personal protective equipment (PPE).
(b) Hazards specific to the job and/or site.
(c) The level of authority, responsibility and training required to complete the job safely.
(d) Reporting relationships identified by management, and any other relationships that may interact with other jobs, SOP's, or work instructions.

UN (United Nations) classification - The classification of dangerous goods as outlined in the document titled 'Recommendations on the Transport of Dangerous Goods', published by the United Nations (UN).

Vulnerable facilities - A category of facility that includes, but is not restricted to, the following:

(a) Multistorey buildings, e.g. above 4 storeys.
(b) Large glass fronted buildings of high population.
(c) Large hospitals or schools.
(d) Public buildings or structures of major historical value.
(e) Major traffic terminals, e.g. railway stations, airports.
(f) Major public utilities, e.g. gas, water, electricity works.

3.0 SAFETY MANAGEMENT SYSTEM

A safety management system shall be in place in all precursor facilities, to ensure the health and safety of the community, employees, property and the environment.

The safety management system shall apply to all visitors and contractors to a precursor facility. The safety management system shall be documented and contain the following minimum requirements:

3.1 A safety policy and plan.

3.2 An annual review of the safety plan.

3.3 A procedure to conduct safety meetings and record the minutes and actions of the meetings.

3.4 A safety audit program.

3.5 A program for investigating accidents and incidents, which shall include management reporting, analysis and review.

3.6 An induction program for employees, contractors and visitors, including use of PPE, any specific hazards on site, the evacuation plan, the location of first aid stations, communications, hot work permits, confined space entry, and any other additional safety or environmental considerations applicable to the site.

3.7 A system of supervision of visitors and contractors in all areas where precursors are manufactured and stored.

3.8 A vehicle operation, control and maintenance system.

3.9 A non-smoking policy.

3.10 A non-drug and alcohol policy.

3.11 A procedure for obtaining MSDS for all chemicals on the site.

3.12 Chemicals register containing MSDS for all chemicals.

3.13 A procedure for the preparation of SOP's for all tasks.

3.14 An employee training system, covering SOP's, site specific procedures and job responsibilities. The system shall include documentation of training, re-training and verification of competency.

3.15 A system to train employees in the correct procedures for the selection, maintenance and use of PPE. As a minimum requirement, safety glasses and safety steel tip footwear shall be worn. Additional PPE may be required for site specific hazards.

3.16 A first aid system including the provision of first aid boxes, a list (posted on the first aid boxes) of personnel trained to provide first aid. There shall be at least one person trained in first aid present on the site.

3.17 A procedure to control lock out/tag out, confined space entry and hot work permits. This shall include, as a minimum, training, documentation, responsibilities and identified authorisation levels.

3.18 A procedure to approve and authorise all processes being conducted on site, including commissioning and waste disposal.

3.19 A procedure for precursor development work.

3.20 A procedure to control the modification of process, equipment, formulas, materials and packaging.

3.21 A system to check trips and alarms, including the documentation of test results.

3.22 A procedure for sampling, sample retention, product testing and recording of pertinent information.

3.23 A critical machine register.

3.24 A program of safe disposal of waste materials and/or precursors that may be sensitised during calibrations and mixing to create an explosive.

3.25 A Site Emergency Response Plan (SERP), which shall include as a minimum –

(a) Signage (containing emergency contact numbers).
(b) A site and area evacuation plan.
(c) Appropriate fire fighting controls and fire risk management plans.
(d) Procedures to address any likely natural disasters and civil unrest.
(e) Procedures that address the loss of normal communication systems.
(f) A communication system throughout the organisation, covering employees, management, systems, regulatory authority, media, remote sites, contractors, visitors and local emergency services.

NOTE: *Persons potentially exposed to hazards relating to a facility, or expected to assist in an emergency shall be trained to an appropriate level. The SERP will be tested and updated annually.*

NOTE: Evacuation guidelines

In the event of an uncontrolled fire (with a substantial source of fuel) capable of engulfing a confined precursor storage vessel, the precursor shall be treated as an explosive and evacuation shall take place. Evacuation shall be to one kilometre unless pre-determined distances, based on NEQ and Protected Works B, Table 3.2.3.2 of AS2187.1-1998, (See Appendix 1) as a minimum, are known, documented and achievable.

4.0 REGULATORY REQUIREMENTS

The manufacturers of precursors shall abide by existing legislation applicable to the manufacture, transportation, storage, handling, and use of all raw materials used in the production of precursors.

Currently, precursors are regulated by several government agencies. It is the responsibility of the owner or operator of the facility containing these materials to determine all applicable existing regulatory requirements pertaining to the facility.

The following requirements should be noted -

4.1 The owner or operator of the facility shall have a copy of relevant licences on site.

4.2 The manufacturer of a precursor is responsible to ensure the precursor has been properly classified.

4.3 When designing new facilities, the requirements of the relevant Australian Standards and regulatory requirements shall be incorporated in the design of the facility.

4.4 Materials used in the manufacture of a precursor shall be separated and segregated and stored as per known incompatibilities.

4.5 The manufacturer or supplier of a precursor shall only sell to organisations holding appropriate licences.

4.6 A copy of this Code of Good Practice shall be provided by the supplier of a precursor to an organisation or person purchasing or storing a precursor.

5.0 DESIGN, LAYOUT & MATERIALS OF CONSTRUCTION

All operators of precursor facilities shall have a documented engineering management system capable of controlling the design, layout and materials of construction of the facility.

The system shall ensure the following -

5.1 Combustible materials used in the manufacture of precursors shall be located and stored in accordance with AS 1940, *The storage and handling of flammable and combustible liquids* and/or applicable local legislation for the separation of dangerous goods. Oxidising materials shall be stored in accordance with AS 4326, *The storage and handling of oxidising agents.*

5.2 Without affecting the safety or efficiency of the operation, the overall plant design shall minimise the number of personnel exposed to any process or storage facility involving precursors.

5.3 The layout of the facility shall minimise the occurrence of the following conditions:

5.3.1 Accidental mixing of incompatible chemicals.

5.3.2 Access to ignition sources.

5.3.3 Explosive atmospheres.

5.3.4 Common-site drainage for incompatible chemicals and/or materials.

5.3.5 Confinement in drains.

5.3.6 Drains or sumps located under structures or process equipment.

5.3.7 Pooling of flammable or combustible chemicals under oxidiser or precursor tanks, pipelines or services.

5.3.8 Routing of fuel and oxidiser lines under, over, or through areas containing oxidisers or precursors.

5.4 The plant layout should provide easy access for materials handling and minimise exposure to, and flow of, uncontrolled materials (especially fuels) into an area containing precursors.

5.5 The impact (e.g. fire, cross contamination, knock-on effects) of a major event is minimised.

5.6 Access to and egress from a facility for the production of precursors shall be controlled. Provisions shall be made for site security and evacuation. Emergency response access shall be provided.

5.7 All electrical equipment in the process and storage facilities used for the precursor shall have a rating of at least IP 65 or equivalent to protect it from corrosion. The design should allow for the isolation of the equipment so as to provide an adequate lockout and tag-out system during maintenance. In areas where a flammability or dust explosion hazard exists, flameproof or 'dust ignition proof' standards shall apply.

5.8 All equipment (electrical, hydraulic, pneumatic etc) shall be designed to ensure safe and easy isolation.

5.9 Mobile equipment containing precursors and materials used to produce an explosive shall not be calibrated in an area where precursors are manufactured or stored, unless the individual components are calibrated separately and do not form an explosive. Where calibration equipment can create an explosive, the calibration equipment shall be separated from any area containing precursors in accordance with the requirements for a process building (mounded) specified in Table 3.2.3.2 of AS2187.1-1998.

5.10 Due to the corrosive and reactive properties of ammonium nitrate-based precursors and in order to prevent the formation of sensitive compounds which may be hazardous (explosive mixtures), metals such as copper and its alloys, lead and zinc, should not be used in an area where a precursor can react with the metal.

5.11 Hazard studies shall be conducted in accordance with Section 7.

5.12 All hazardous chemicals and process piping shall be clearly labelled.

6.0 GUIDANCE NOTE ON LOCATION OF NEW PRECURSOR FACILITIES

Although quantitative risk analysis can demonstrate that risks associated with precursor facilities are acceptable, the potential consequences of an incident may be so severe that reduction of the consequences by choosing a more remote location must be considered. In assessing the suitability of the location of a precursor facility the following separation distances shall be independently considered-

(a) The distance from the precursor facility to a concentration of population.

(b) The distance from the precursor facility to a vulnerable facility.

(c) The distance from an explosives facility to a precursor facility.

To assist in assessing the suitability of the location of a precursor facility in relation to concentrations of populations, vulnerable facilities, and to nearby explosives facilities, a decision tree and two situations (with examples) are provided.

Situation 1. relates to precursor facilities that are close to concentrations of population.

Situation 2. relates to precursor facilities, some of which are adjacent to explosives facilities, remote from concentrations of population.

The distances given for protected works B, in Table 3.2.3.2 of AS2187.1-1998 shall be used when determining the distance between a concentration of population and a precursor facility and/or a vulnerable facility and a precursor facility. In applying this table, the net explosive quantity (NEQ) of the precursor site shall include the mass of precursor and fifty percent (50%) of the mass of ammonium nitrate prill, on the site; unless the ammonium nitrate is separated from the precursor by the 'distances to ammonium nitrate storage' given in Table 3.2.3.2 of AS2187.1-1998.

Time and ease of evacuation are of prime importance when defining a concentration of population. The term however, shall include hospitals, schools, and high density housing.

NOTE: *The decision tree does not consider the location of explosive facilities. Their location, which is subjected to regulatory authority is outside the scope of this code.*

Decision Tree – Siting of Precursor Facilities

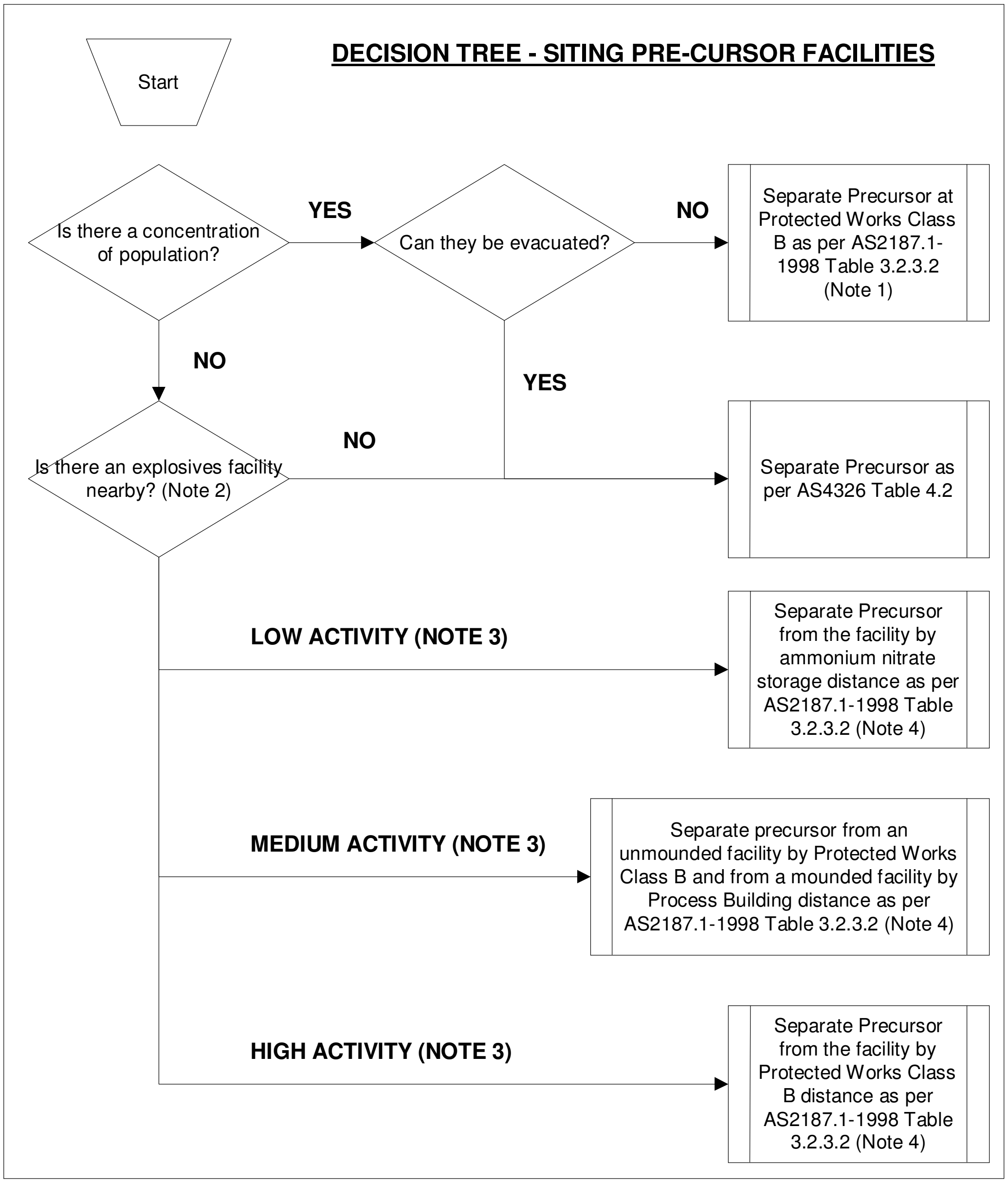
DECISION TREE - SITING PRE-CURSOR FACILITIES
Start
Is there a concentration of population?
YES
Can they be evacuated?
NO
Separate Precursor at Protected Works Class B as per AS2187.1-1998 Table 3.2.3.2 (Note 1)
NO
YES
Is there an explosives facility nearby? (Note 2)
NO
Separate Precursor as per AS4326 Table 4.2
LOW ACTIVITY (NOTE 3)
Separate Precursor from the facility by ammonium nitrate storage distance as per AS2187.1-1998 Table 3.2.3.2 (Note 4)
MEDIUM ACTIVITY (NOTE 3)
Separate precursor from an unmounded facility by Protected Works Class B and from a mounded facility by Process Building distance as per AS2187.1-1998 Table 3.2.3.2 (Note 4)
HIGH ACTIVITY (NOTE 3)
Separate Precursor from the facility by Protected Works Class B distance as per AS2187.1-1998 Table 3.2.3.2 (Note 4)

Figure 1. Facilities in close proximity to concentrations of population or vulnerable

Note 1. *The distance to the concentration of population from the precursor facility is determined by the mass of the precursor. If there is an ammonium nitrate store within the distance specified in Table 3.2.3.2 of AS2187.1-1998, 50% of the mass of ammonium nitrate shall be included in the precursor mass.*

Note 2. *Separation distances from explosives facilities to the protected works A and B shall also be considered separately.*

Note 3. *The definitions of activity are as follows:*

Low - not permanently attended (1-2 people).
Medium - 1-10 people at peak activity.
High - >10 people at peak activity.

Note 4. *The distance to the explosive facility from the precursor facility is determined by the mass of explosive in the explosives facility. Separation and segregation of storage within the precursor facility shall be considered when designing the detailed layout of the facility.*

Situation 1: *Facilities in close proximity to concentrations of population or vulnerable sites*

The following examples are provided as guidance to assist in determining distances between precursor facilities and possible concentrations of populations. The Protected Works Class B distance, given in Table 3.2.3.2 for a NEQ of 50 tonnes, is 820m.

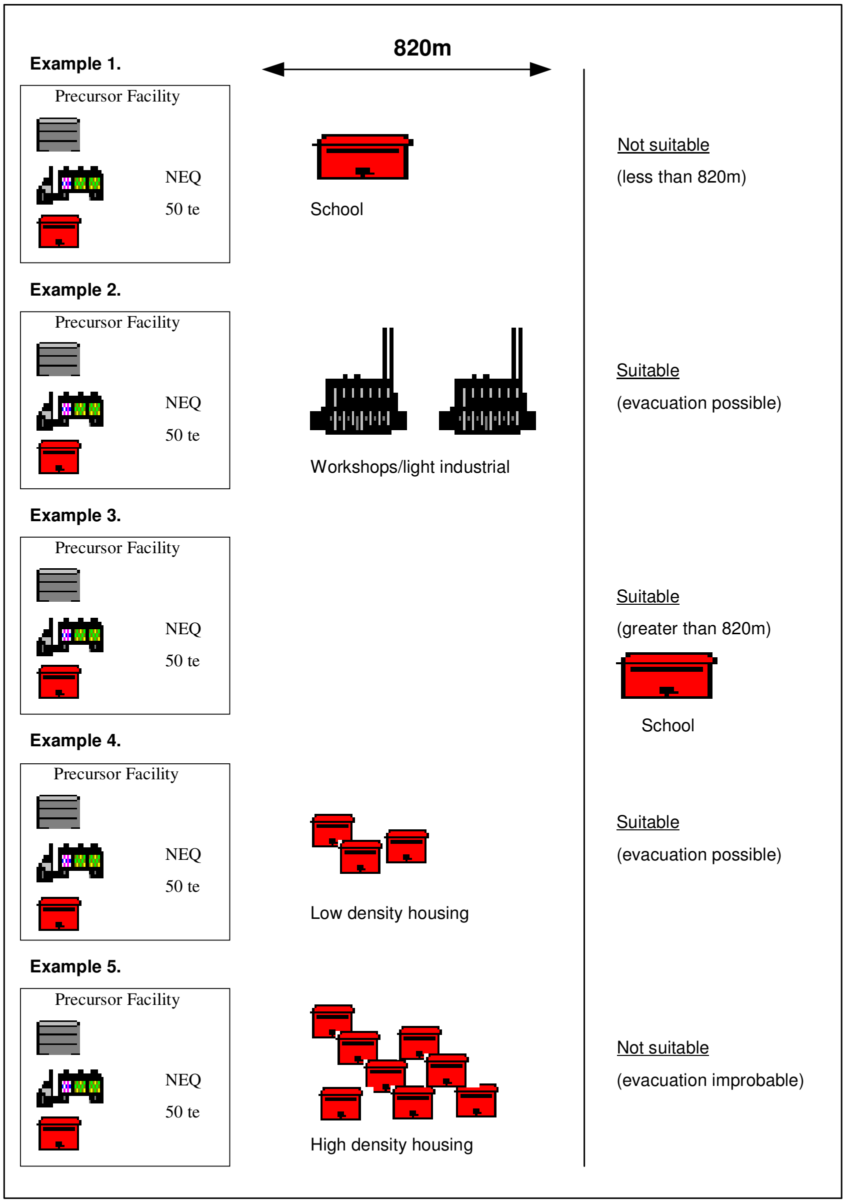

Figure 2. Facilities in close proximity to concentrations of population or vulnerable sites

Minimum distances between precursor facilities and concentrations of population and vulnerable facilities shall be as given for Protected Works, Class B, in Table 3.2.3.2 of AS2187.1-1998.

Situation 2: Precursor facility, remote from a concentration of population

Example 1: No explosives facilities nearby.

NOTE: *The precursor facility is located in an area remote from any concentration of population and on a site where explosives are not manufactured, stored or handled.*

The minimum separation distance required from the precursor facility to protected places and boundaries shall be that given in AS 4326-1995, The Storage and Handling of Oxidising Agents.

MINIMUM SEPARATION DISTANCES FOR BULK LIQUID CONTAINERS FROM PROTECTED PLACES AND BOUNDARIES

AS 4326 - 1995 Table 6.4

Capacity of Container m^3	Minimum Distance from Protected Places & Boundaries m		
	PGI	PGII	PGIII
≤ 1.5	5	3	3
$>1.5 \leq 10$	10	5	5
$>10 \leq 50$	15	8	5
>50	20	12	8

NOTE: *Where the above separation distances are applied to on-site protected places that are an integral part of the storage, processing or handling of oxidising agents, such distances may be reduced subject to appropriate risk identification, assessment and control.*

Situation 2: Precursor facility, remote from a concentration of population

Example 2: Low precursor activity; explosives facilities nearby

NOTE: *The precursor facility is not permanently manned and is not under the same management as the explosives facility. Precursor storage tanks are located near the explosives facilities primarily for servicing bulk operations.*

The minimum separation distance between the precursor and explosives facilities shall be in accordance with the distance to ammonium nitrate storage (unmounded or mounded) given in Table 3.2.3.2 of AS2187.1-1998. This distance should ensure propagation does not occur between the explosives process building and/or magazine and the precursor storage facility. The distance shall be determined from the NEQ of the explosives stored on the site and/or in the manufacturing process.

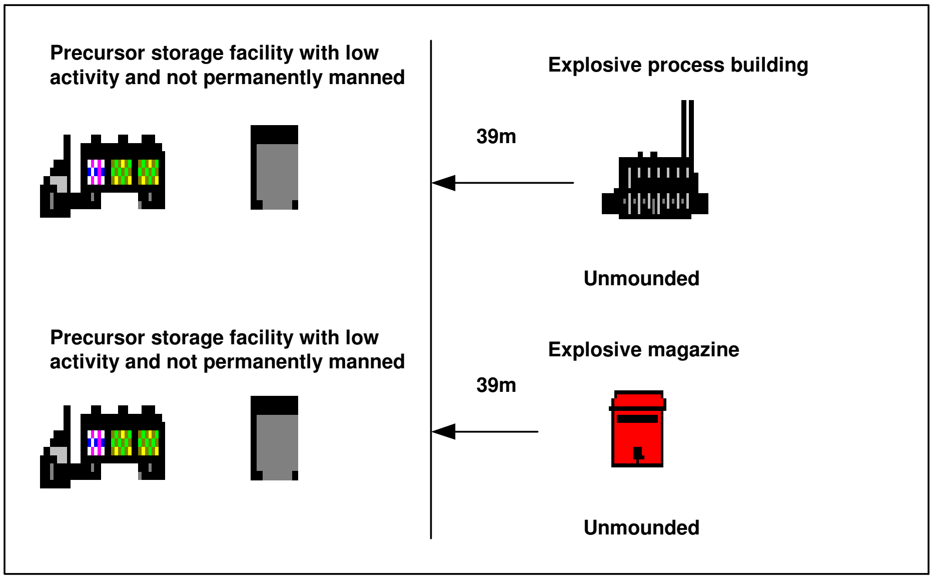
Precursor storage facility with low activity and not permanently manned
Explosive process building
39m
Unmounded
Precursor storage facility with low activity and not permanently manned
Explosive magazine
39m
Unmounded

Figure 3. Low precursor activity, explosives facilities nearby

The distance required for a NEQ of 10 tonnes (Unmounded) = 39 metres (see Table 3.2.3.2 AS 2187.1-1998.)

Situation 2: Precursor facility, remote from a concentration of population

Example 3: Medium precursor activity*; *explosives facility nearby

NOTE: *The precursor facility has a medium level of activity, (less than 10 people) and is located near to an explosives facility.*

The minimum separation distance between the precursor and explosives facilities shall be in accordance with the following distances:

If the explosive facility is **mounded**; the distance shall be determined by process building distances given in Table 3.2.3.2 of AS2187.1-1998; or

If the explosive facility is **unmounded**; the distance shall be determined by the distance to protected works Class B (unmounded) in Table 3.2.3.2 of AS2187.1-1998. The distance shall be determined from the NEQ of the explosives stored on site and/or in the manufacturing process.

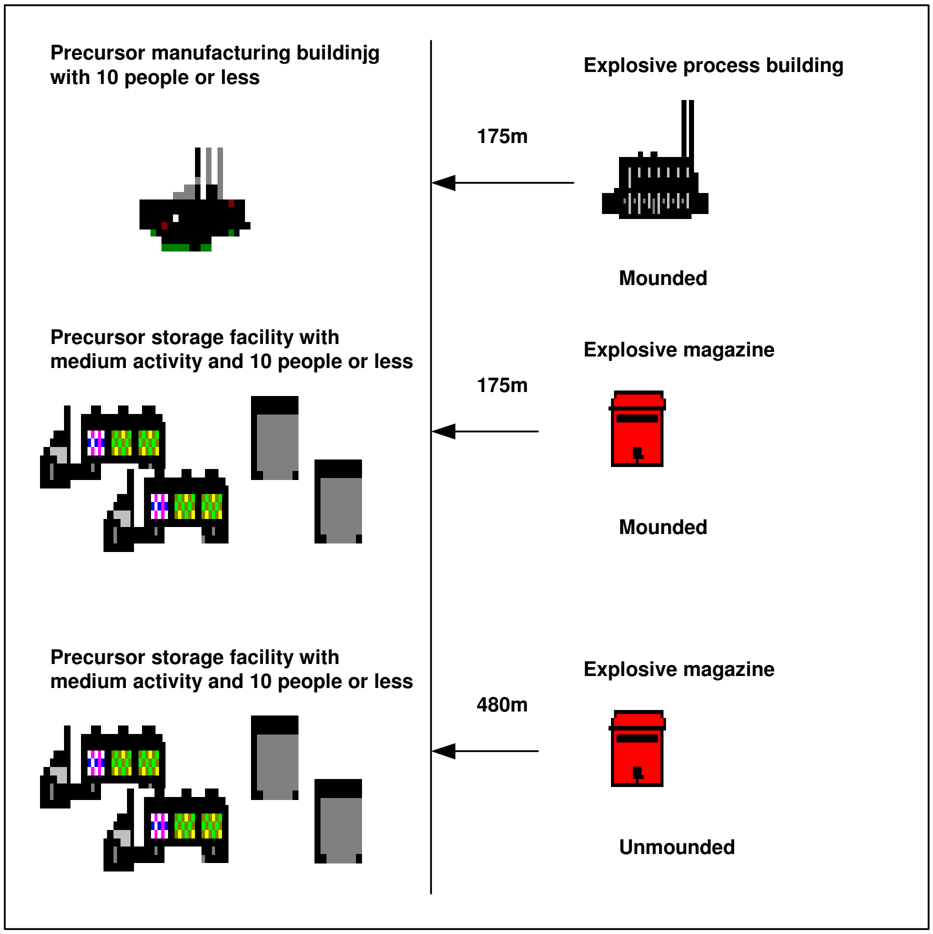
Precursor manufacturing buildinjg with 10 people or less
Explosive process building
175m
Mounded
Precursor storage facility with medium activity and 10 people or less
Explosive magazine
175m
Mounded
Precursor storage facility with medium activity and 10 people or less
Explosive magazine
480m
Unmounded

Figure 4. Medium precursor activity, explosives facilities nearby

The distance required for a NEQ of 10 tonnes (mounded) is 175m (See Table 3.2.3.2 of AS2187.1-1998). The distance required for a NEQ of 10 tonnes (unmounded) is 480m (See Table 3.2.3.2 of AS2187.1-1998, column “Protected Works- Class B”.

Situation 2: Precursor facility, remote from a concentration of population

Example 4: High precursor activity; explosives facilities nearby

NOTE: *The precursor facility has a high level of activity (more than 10 people), contains several tanks, and is near to an explosives facility.*

The minimum separation distance between the precursor and explosives facilities shall be in accordance with the distance to protected works Class B (mounded or unmounded) in Table 3.2.3.2 of AS2187.1-1998. The distance required shall be determined by the NEQ of the explosives on the site and/or in the explosives manufacturing process.

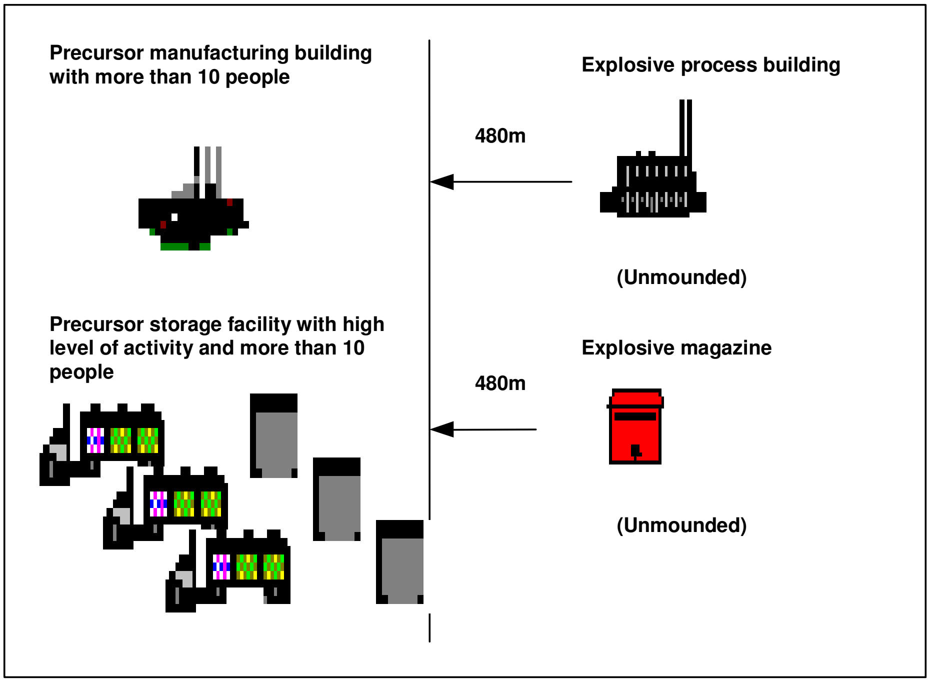
Precursor manufacturing building with more than 10 people
Explosive process building
480m
(Unmounded)
Precursor storage facility with high level of activity and more than 10 people
Explosive magazine
480m
(Unmounded)

Figure 5. High level of precursor activity, explosives facilities

The distance required for a NEQ of 10 tonnes (unmounded or mounded) is 480 metres (see Table 3.2.3.2 of AS2187.1-1998).

NOTE: *Where a precursor storage or manufacturing facility is an integral part of an explosives facility, the separation distance between the precursor and explosive shall be as given for ammonium nitrate in Table 3.2.3.2 of AS2187.1-1998. This is to ensure that propagation does not occur between the explosives and the precursor. If the minimum distance for ammonium nitrate is not maintained, the entire mass of the precursor shall be included with the NEQ of the explosive facility, when determining separation distances.*

7.0 HAZARD STUDIES

The engineering management system shall include documented hazard studies for all facilities. Hazard studies should be conducted by qualified, multi-disciplinary teams which include plant operators from similar types of facilities.

The following minimum considerations should be made in such studies -

7.1 The general site layout for the flow of materials.

7.2 Pipe work and instrumentation drawings (P&ID).

7.3 Public, private, site personnel, and vulnerable sites within a 2 kilometre radius (identified on the plot plans).

7.4 Site access, site security and utility requirements.

7.5 Materials of construction for tanks, process equipment and other materials in contact with, or exposed to, precursors.

7.6 Separation and segregation distances between incompatible dangerous goods.

7.7 Material handling procedures, ergonomics, equipment types and classification.

7.8 Foreign bodies (tramp material).

7.9 Site and process limits.

7.10 Personal exposure and requirements for the use and care of PPE.

7.11 Process equipment, control logic, interlocks and equipment limitations.

7.12 Hazardous chemicals their physical properties and compatibilities and the provision of MSDS.

7.13 Standard operating procedures (SOP's), training and qualifications.

7.14 The management reporting structure and lines of communication.

7.15 Site specific conditions including the staff's language and customs.

7.16 Health, safety and environmental issues and quality control.

7.17 Federal, state, territory and local regulations, including building or equipment design codes.

7.18 Provision for fire fighting controls, emergency response and control of spills.

7.19 Earthing of equipment and buildings.

7.20 Lightning protection, including historical information on lightning activity.

7.21 The prevention or minimisation of waste generation.

7.22 The containment, on-site, of all wastes or residues from chemicals or materials.

7.23 The mitigation of the effects of incidents and accidents, e.g. by mounding reduction of quantities, separation distances.

7.24 Maintenance schedules for equipment.

7.25 Auditing processes eg for buildings, equipment, procedures and chemicals.

7.26 The prevention of uncontrolled heat, friction, pressure, confinement and cross contamination.

7.27 A review of pump protection systems (see also Section 8.7)

8.0 PUMPS

All sites shall have a documented precursor pump management system which shall include the following requirements:

8.1 All pumps shall be reviewed and authorised for use prior to installation and operation.

8.2 All pump applications, limitations, classifications and safety protection systems shall be defined in the engineering safety review and shall be authorised by the organisation for use with the technology involved and with the chemicals or materials used in the process.

8.3 Each pump shall be uniquely identified.

8.4 There shall be a program to document general and specific inspections, corrective maintenance and major repairs.

8.5 Pump components that come into direct contact with a precursor shall be manufactured from materials that are compatible with the chemicals used in the precursor.

8.6 All pumps used in the handling of a precursor shall have pump protection systems that are regularly tested and documented. The system shall be capable of detecting and preventing dead heading and dry operation of the pump.

8.7 Pump protective elements shall be considered in the hazard study which will address the requirements for each type of product, process or application. Examples of pump protective elements are -

8.7.1 Thermofuse or temperature trips at the pump inlet, mid-point or outlet.

8.7.2 Over-and-under pressure trips, near the pump outlet.

8.7.3 Bursting discs.

8.7.4 Drive torque limit devices.

8.7.5 Drive speed limiting devices.

8.7.6 Feed hopper level controls.

8.7.7 No flow detection.

8.7.8 Time out or countdown automatic shut down system.

8.8 All tanks, hoppers, and pump systems shall be designed so as to prevent the introduction of foreign bodies into the process. This may include the use of filters or screens on the inlets or on tanks supplying raw materials to the manufacturing process.

8.9 The protective system shall include signs in areas where foreign bodies could be introduced into the process, and procedures to regularly inspect all equipment used in the process.

8.10 Pumps shall be maintained by personnel who are accredited and/or authorised by the organisation. Suppliers of pumps shall be accredited and spare parts shall be supplied by the original manufacturer or its authorised distributors.

8.11 Pumps shall be operated in one direction only unless an effective pump management system, eg; pump monitors, interlocks, procedures, signs and training, is in place, in order to control the potential hazards of the operation.

8.12 All incidents involving abnormal conditions eg no flow, excessive heat and/or high pressure, shall be acted on immediately. A defined procedure including an investigation by an authorised representative of the organisation shall be conducted.

8.13 A documented pump incident report shall be completed identifying the causes, operating conditions and corrective actions taken to prevent the occurrence of similar incidents.

8.14 A pump incident report distribution system shall be implemented so that relevant personnel are notified when a serious incident occurs. This shall include personnel within the organisation, the operator of the site where the incident occurred and relevant regulatory authorities.

8.15 Operators shall be trained in the hazards associated with pumping precursors, appropriate procedures, fault recognition and response. Such training shall be documented.

8.16 Pump inlets and outlets shall be identified.

8.17 Approved personnel shall be in attendance whenever pumps are operated.

8.18 Pumps shall be marked with the following message: “Only authorised personnel may carry out work on this pump.”

9.0 MAINTENANCE

Every facility shall have a documented preventative and corrective maintenance program for all equipment.

The maintenance program shall contain the following minimum requirements -

9.1 A preventative maintenance and inspection program.

9.2 Routine and corrective maintenance procedures.

9.3 A policy on the use of original and/or approved parts.

9.4 Competent maintenance personnel, whose competency is documented.

9.5 Retention of historical maintenance records, including sign-off procedures.

9.6 Identification of all critical machine system components.

9.7 An inventory of all critical equipment spares.

9.8 A 'tag out' or 'lock out' procedure for all maintenance functions.

9.9 A permit system for confined space entry and hot work.

9.10 A training program covering the maintenance of critical machine systems including re-training and verification of competencies.

9.11 Decontamination procedures for parts and equipment that have been in contact with precursors prior to maintenance or replacement.

9.12 A sign-off procedure after maintenance work on critical machine systems has been completed.

10.0 MATERIALS HANDLING

10.1 Every facility shall have a materials handling policy in order to identify areas where personnel could be injured due to improper handling of materials. Ergonomic studies should be used to identify and correct deficiencies in equipment design.

10.2 All materials shall be stored and handled according to industry recommendations based on the compatibility of the materials, information provided in MSDS's and applicable regulatory requirements.

10.3 All materials handling equipment shall be reviewed in order to ensure that it is suitable for use in terms of service, design limits, classification and compatibility with the chemicals used in the process.

10.4 Adequate space shall be provided around all process equipment to allow for the proper segregation of incompatible chemicals and materials, provide room for maintenance, and to provide access for emergency response equipment and personnel.

10.5 Containers and receptacles for raw materials shall be properly labelled. Containers shall be impervious to and compatible with the chemicals materials being kept in them.

10.6 A supply agreement identifying the exact specification for each component shall be in place between the manufacturer of the precursor and the supplier of the raw materials used in its production.

★ **Careful consideration must be given to the manner in which all oxidisers are stored, handled and separated from fuels, combustible materials and other incompatible materials.**

NOTE: *Sodium nitrite is commonly used in the industry to create an explosive mixture.*

This strong oxidising agent shall be stored in sealed containers and shall be separated from all other oxidising agents. Sodium nitrite shall only be mixed with other oxidising agents in controlled applications to a formula approved by the organisation.

★ **If this chemical is improperly mixed with ammonium nitrate and/or other ammonium salts, a violent reaction will occur and under certain conditions this mixture will detonate**

11.0 PERSONNEL

Every precursor facility shall have a documented training program with demonstrated competency assessments for each employee including the following minimum requirements:

11.1 Job descriptions, including responsibilities, authorities, and reporting structures.

11.2 Minimum educational or industry experience standards for personnel in each job classification.

11.3 Training requirements for each job classification.

11.4 Induction program for all employees, contractors, and visitors.

11.5 Safety, health, and environmental programs which specifically include spill prevention, waste minimisation and disposal and confined space entry.

11.6 Minimum physical and mental health requirements at pre-employment.

11.7 Management structure, with lines of responsibility and authorities.

11.8 Appropriate skills training and licensing of employees as required for operating specialised equipment e.g. forklifts, boilers and cranes. An annual review and renewal of training and licensing requirements shall take place.

11.9 Standard operating procedures, site specific work instructions, annual reviews and updates.

11.10 Specific training in precursor handling equipment (e.g. pumps, valves, pump protection systems, hydraulic power units and compressors) including operating conditions, limitations and potential hazards.

11.11 Verification of the competency of personnel in understanding standard operating procedures.

11.12 Maintenance personnel in the use of approved parts, modifications, hot work system, 'lock out', 'tag out' and decontamination procedures.

11.13 The recognition of hazardous chemicals and their incompatibilities in the work place.

11.14 Site specific PPE requirements, including training in the proper use of and care of the equipment.

11.15 Emergency response and evacuation procedures.

11.16 Training in the location and proper use of all emergency equipment including fire extinguishers, fire hoses, alarms, first aid stations and eye wash stations.

11.17 All drivers transporting precursors must be qualified and authorised to relevant federal, state and territory requirements.

11.18 All drivers transporting precursors shall be trained in appropriate emergency response.

12.0 WASTE MANAGEMENT AND ENVIRONMENTAL CONTROLS

Waste management, minimisation, and environmental protection programs shall be incorporated into the design and operation of every facility.

12.1 All waste materials shall be kept in separate, labelled and sealed containers. Such materials shall be properly separated by the distance required by dangerous goods legislation based on the compatibility of the materials. Each separate area shall be placarded and located so as to prevent cross contamination if a spill occurs. A common drainage system shall not be used in areas where incompatible materials are stored.

12.2 The calibration of equipment shall be undertaken so as to minimise the amount of waste produced. Each component should be calibrated separately. All waste materials produced during the calibration process shall be stored in a designated waste area. Containers used to store such waste material shall be compatible with the material being kept, and shall be sealed and labelled.

12.3 All waste shall be contained in order to prevent it contaminating the environment.

12.4 Waste materials, including packaging, shall not be buried or burnt on-site. They shall be removed and disposed of in accordance with applicable environmental, organisational, and legislative guidelines.

12.5 All procedures must give priority to the minimisation of waste.

12.6 A waste recycling program should be used to reprocess waste materials generated during calibration or operation. This should be controlled by strict guidelines to ensure all safety precautions are taken prior to the commencement of the process.

12.7 A hazard review shall be completed and any deviations corrected prior to the commencement of the process.

12.8 The organisation shall comply with all relevant environmental regulations and licence conditions.

★ **Special consideration must be given to precursors which may create an explosive during the calibration process.**

13.0 TRANSPORT

The transport of precursors is regulated by the Australian Code for the Transportation of Dangerous Goods by Road and Rail (ADG Code). It is the responsibility of everyone involved in the transport of a precursor to comply with regulations in the ADG Code. Mobile manufacturing units that are used to transport and blend a precursor with other ingredients to create an explosive may require an additional licence from the appropriate regulatory authority for explosives.

The following recommendations also apply:

13.1 The organisation offering a material that is classified as a precursor shall ensure that the prime contractor involved for the haulage of the material holds the appropriate licence to transport dangerous goods. The equipment used by the contractor should be reviewed by the organisation offering the material for shipment in order to ensure that the equipment is suitable for the task and is maintained in a safe condition.

13.2 In the event of an uncontrolled fire involving a transport vehicle carrying a precursor, the precursor should be treated as if it were an explosive. The area around the fire should be evacuated for a distance of at least 1 kilometre. Shorter distances can be set if exact quantities of precursor and ammonium nitrate are known. In such cases distances given for protected works B in Table 3.2.3.2 of AS2187.1 shall apply.

★ **The fighting of a fire involving a vehicle carrying a precursor should only be attempted while the fire is controllable and has not engulfed the tank that contains the precursor.**

13.3 The emergency procedure guide (EPG) or Dangerous Goods Initial Emergency Response Guide, shall be used as a basis for managing a hazardous situation involving a precursor.

13.4 There shall be a procedure in place to deal with any spillage during the loading, unloading and transport of the precursor.

13.5 Any vehicle transporting a precursor shall abide by applicable federal, state or territory regulations regarding authorised weight limits. The maximum design limit recommended by the manufacturer of the equipment shall not be exceeded.

13.6 A precursor shall not be transported on a vehicle carrying a packaged explosive.

13.7 When being transported by water, a precursor shall be handled in accordance with the recommendations of the relevant port authority. Additional separation and segregation requirements may apply while the precursor is on the wharf and aboard the ship. Containers are to comply with the IMDG Code and other IMO requirements for the class of material being transported.

13.8 Annual safety inspections of prime movers and process equipment shall be conducted on all precursor transport and precursor mobile manufacturing units.

13.9 Routes of precursor transport and mobile manufacturing vehicles shall be reviewed and documented to ensure minimum impact on the community both in normal duties and in times of emergencies.

14.0 APPLICATIONS FOR NEW PRECURSOR FACILITIES

It is suggested applications are presented to regulatory authorities under the sections detailed below. These sections correspond with those of this code. Each section should address the general conformance or otherwise of the new proposal to the requirements of the code and highlight specific areas of interest or unique features of the proposal.

It is recognised that applications will vary in size and level of detail owing to their different scopes. Unusual requirements should be discussed prior to submitting a proposal.

SECTION

1. **Scope**
   A review of the proposal detailing location, equipment, processes, inventories, products, amenities etc.
2. **Definitions**
   Generally as per code.
3. **Safety Management**
4. **Standards, Codes & Regulations**
   Listing of key standards, codes and regulations reviewed for the proposal.
5. **Design, Layout & Materials of Construction**
6. **Guidance Note on Location of NEW Precursor Facilities**
7. **Hazard Studies**
   Discussion of any significant findings (including list of critical machine systems).
8. **Pumps**
   List of the type and number of process and delivery pumps on site and their protective systems.
9. **Maintenance**
10. **Materials Handling**
    Include a list of materials, maximum inventory and methods of handling.
11. **Personnel**
12. **Waste Management & Environmental Controls**
13. **Transport**

15.0 APPENDIX 1. TABLE 3.2.3.2 (AS2187.1-1998)

QUANTITY DISTANCES FOR THE STORAGE OF DIVISION 1.1, 1.5 OR 1.6 EXPLOSIVES

NEQ stored (Q) kg	Separation distance (D), m								
	Protected Works Class A✈ as defined in AS 2187.0	Protected works Class B✣ as defined in AS 2187.0		Vulnerable Facilities✪	To other explosives storage		Associated works		
							To process building		To ammonium nitrate storage (see Note 5)
		Unmounded	Mounded		Unmounded❋	Mounded✷	Mounded♦ (see Notes 7,8,9 and 10)		Unmounded♠
50	25	180	30	180	18	9	18	30	7
100	25	180	38	210	23	12	23	38	9
200	35	180	52	260	29	15	29	47	11
300	45	180	68	300	33	17	33	54	13
400	55	180	82	330	36	18	36	59	14
500	63	180	95	360	39	20	39	64	15
1000	100	180	150	450	48	24	553	80	18
1500	135	200	200	510	55	28	66	92	22
2000	160	240	240	560	61	31	78	105	23
2500	185	280	280	610	66	33	90	110	25
3000	205	305	305	650	70	35	105	120	26
4000	235	350	350	710	77	39	130	130	29
5000	255	380	380	760	83	42	140	140	31
7500	295	435	435	870	94	47	155	155	35
10000	320	480	480	960	105	52	175	175	39
15000	370	550	550	1100	122	61	200	200	45
20000	405	610	610	1220	135	66	220	220	49
25000	435	650	650	1300	145	71	235	235	53
30000	460	690	690	1380	150	75	250	250	56
40000	510	760	760	1520	165	83	275	275	62
50000	550	820	820	1640	180	89	295	295	67
75000	625	940	940	1880	205	103	340	340	77
100000	690	1040	1040	2080	225	115	375	375	84
120000	730	1100	1100	2200	240	120	395	395	89
140000	770	1160	1160	2320	250	125	420	420	94
160000	810	1220	1220	2440	265	135	435	435	98
180000	840	1260	1260	2520	275	140	455	455	105
200000	870	1300	1300	2600	285	145	470	470	110
250000	940	1400	1400	2800	305	155	510	510	115

NOTES TO TABLE 3.2.3.2:

1. Table 3.2.3.2 is based on TNT as the donor explosive. The net explosive quantity (NEQ) may be adjusted for explosives of different output.

2. Magazines may be situated closer to each other than given in Table 3.2.3.2, provided the combined NEQ in all such magazines is used when determining the separation distances to process buildings and protected works.

3. Natural barriers, e.g. hills or mountains, may permit reduced separation distances.

4. For segregated storage of Division 1.6 explosive articles, the NEQ used in Table 3.2.3.2 should be the quantity of explosive contained in one of the biggest articles stored.

5. Where a mound exists between a storage of explosives and an ammonium nitrate store, the separation distance may be reduced to –

   (a) 5m for Q 5 000 kg;
   (b) 10m for Q > 5 000 50 000kg; and
   (c) 20m for Q > 50 000kg.

   Where Q is the quantity of explosives stored.

6. Where ammonium nitrate is stored closer to the explosives than the separation distance, then 50% of the quantity of ammonium nitrate should be added to the explosives quantity to obtain the resultant NEQ.

7. For process buildings of significant populations, e.g. greater than 10 people, a minimum distance of 270m should be considered between storage of Division 1.1 explosives. In buildings where shrapnel or displaced building materials may pose a threat, consideration should be given to using larger separation distances than those given in Table 3.2.3.2 for protected workers.

8. The standard Process Building Distance is given by the formula $D = 8.0\ Q^{1/3}$. At this distance the major effects to be considered are the peak side-on overpressure, which is anticipated to be no greater than 20 kPa (3psi) and projections which are extremely difficult to quantify but may be very significant.

   The smaller distances quoted in the table for quantities below 4000kg will still provide a reasonable degree of protection for persons within a process building at the exposed site. These smaller distances are based on impulse considerations since smaller explosive events are of shorter duration and a higher pressure is therefore needed to produce the same level of damage as that expected at distances given by the above formula for much larger quantities of explosives. However, the actual risk depends on the type of structures involved as on the quantity of explosives at the donor site. It is rather unpredictable in general terms, although it can be evaluated in individual cases. The smaller distances should only be used with the following provisos –

(a) the number of persons in the process building is small (up to 10); or
(b) the combination of buildings, donor charge, barricades and equipment are such that there is less risk of projectile damage; or
(c) a combination of (a) and (b).

9. When siting and designing process buildings the following effects should be considered: a person in a building designed to withstand the anticipated blast loading and without windows would merely startled by the noise of the explosion at an adjacent site whereas a person in a brick building with windows might suffer eardrum damage, or suffer injuries indirectly through being pushed by a blast and consequently impacting on hard objects, or through possible collapse of the building.

10. Where there is a significant risk to personnel in process buildings from debris projected from a donor site containing explosives of Class 1.1/1.5, distances provided for protected works Class B in Table 3.2.3.2 should be considered.

✈ $D = 1.0 Q^{2/3}$ for Q 2500 kg
$D = 3.6 Q$ ½ for 2500 , Q 4500 kg
$D = 14.8 Q^{1/3}$ for $Q > 4500$ kg

At this distance the direct effects of blast, radiant heat and projections are minor. However, full Class B protected work distances should be used for roads if the nature of the traffic is e.g. constant, dense or fast, so that the reaction of drivers to a sudden blast would result in unacceptable damage or injury.

✤ $D = 1.5 Q^{2/3}$ for Q 2500 kg
$D = 5.5 Q^{1/2}$ for 2500 , Q 4500 kg
$D = 22.2 Q^{1/3}$ for $Q > 4500$ kg

This distance is not sufficiently large to prevent breakage of glass and other frangible panels or cladding used in construction. Where such construction may present significant hazard, for example multistorey glass-fronted buildings, increased distances as for vulnerable facilities should be used.

There may be a significant hazard from division 1.1 explosives due to fragments and a considerable amount of debris. This hazard may be tolerable for sparsely populated areas where there would be a small expectation of damage and injury from such projections, but in densely populated areas the hazard may pose an unacceptable risk. While a minimum distance of 180 m has been provided for unmounded magazines, consideration should be given to 400 m from centres of population, irrespective of mounding or quantity of explosives.

Where shrapnel is unlikely to result from any explosion, the minimum distances may be discounted.

✪ $D = 44.4\ Q^{1/3}$

This distance represents the minimum distance that should be allowed for vulnerable facilities or locations of special significance.

❇ $D = 4.8\ Q^{1/3}$
✷ $D = 2.4\ Q^{1/3}$
♦ $D = 8.0\ Q^{1/3}$
♠ $D = 1.8\ Q^{1/3}$